

Title: Epididymitis rates in Australian hospitals 2009 to 2018; ecological analysis

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ABSTRACT

Objectives: To investigate rates of acute epididymitis diagnosed in Australian hospital settings.

Methods: Yearly hospital admission and emergency department (ED) rates of epididymitis as primary diagnosis were calculated for 15-44 year old men for three states (Victoria, New South Wales, Queensland) from 2009 to 2014 using population denominators. Zero inflated poisson regression models were used to analyse variation in rates by year, age, and residential area. Additionally, we investigated national epididymitis admission trends from 2009 to 2018 using generalised linear models.

Results: Between 2009 and 2014 there was a total of 7375 admissions and 17281 ED presentations for which epididymitis was the main reason for care. Most epididymitis diagnoses (94.0% in admissions, 99.7% in EDs) were without abscess, and 2.5% of admissions were for chlamydial epididymitis. Almost a quarter (23.3%) of epididymitis diagnosed in EDs resulted in hospital admission. In 2014, the epididymitis rate per 100 000 men was 38.7 in admissions and 91.9 in EDs. Comparing 2014 with 2009, the overall epididymitis diagnosis rate increased in admissions by 32% (adjusted incident rate ratio (aIRR) 1.32, 95%CI 1.20 to 1.45) and in ED attendances by 40% (aIRR 1.40, 95%CI 1.31 to 1.49). By age, the highest rates were among men 35-44 years in admissions and men 15-24 years in EDs. National admission rates of epididymitis during 2009-2018 showed a similar pattern.

Conclusion: Rates of epididymitis diagnosis in hospital admission and ED presentations increased. Different age-related rates in these settings suggest a different aetiology or differential severity by age group.

BACKGROUND

Acute epididymitis is an inflammation (usually unilateral) caused by infection of the epididymis that can also affect the adjacent testicle and cause epididymo-orchitis.(1, 2) Typical symptoms include recent onset pain and swelling. The sexually transmissible infections (STIs) *Chlamydia trachomatis* (chlamydia) and *Neisseria gonorrhoeae* (gonorrhoea) are often implicated for men aged <35 years. Other causes of acute epididymitis include enteric pathogens (e.g. *Escherichia coli*) transmitted via insertive anal intercourse or urinary tract pathogens that are common for older men.(1, 2)

Over recent years, Australia, like many high-income countries has experienced increasing STI rates. For males, diagnosis rates per 100,000 population of chlamydia increased from 231 to 395 and gonorrhoea from 47 to 174 between 2009 and 2017.(3) While testing is likely to contribute to such increases, surveillance data suggest increasing chlamydia and gonorrhoea incidence in heterosexual and men who have sex with men.(4) In this context epididymitis rates could change; potentially rising with increasing STI transmission or declining with extra testing that detects STIs before progression to complications. Australian epididymitis rates are largely unknown. Where reported, epididymitis rates remained constant in hospital admissions (1992-2001)(5) and general practice clinics (1998-2003).(6)

We previously reported on female STI-related morbidity in Australia(7) and here provide updated yearly epididymitis rates in Australian hospitals.

METHODS

We undertook an ecological study using hospital admission and emergency department (ED) data for epididymitis in the three most populous Australian states [Victoria, New South Wales (NSW) and Queensland]. These data were obtained for the years 2009 to 2014 for purposes of

analysing a chlamydia testing intervention trial(8) we now apply the same methods as described in our study of female STI-associated morbidity.(7) We obtained non-identifiable, line-listed records from State-specific hospital admission and ED datasets for all 15-44-year-old patients with a main epididymitis diagnosis. Hospital admissions datasets included data for all hospitals in the state. ED datasets included data for presentations to public (government-funded) hospitals with a designated ED. Data reporting from EDs was voluntary; therefore as in our earlier study(7) we only included records from hospitals contributing data in all study years and if the yearly number of ED presentations varied by $<50\%$ and $\geq 75\%$ records had a principal diagnosis coded. Admissions and ED data items included year, age group, residential postcode and principal diagnosis code. Records with an International Classification of Diseases 10th Revision (ICD-10) of N45, N45.9, A56.1 or A54.2, or, concordant ICD-9 or Systematized Nomenclature of Medicine code were classified as epididymitis. Denominator data at postcode level comprised the annual male estimated residential population (ERP). Based on standard definitions, we classified 1678 postcodes for remoteness and socio-economic status (SES). We prepared two datasets comprising a) all admissions and b) all ED attendances with a principal epididymitis diagnosis and population per postcode.

Additionally, to provide more recent and national rates, for men aged 15-44 we obtained the annual ERP, and, aggregated yearly hospital separations data with a primary epididymitis diagnosis for all Australia during 2009-2018. ED data nationally were not publicly available for this period.

Data were analysed using Stata 16 (StataCorp, College Station, Texas, USA). We examined variation in rates by year, age-group, remoteness and SES using univariable and multivariable zero-inflated poisson regression models. We included residential area measures to assess whether

rates differed between areas of different affluence or remoteness. Using likelihood ratio tests, we investigated interactions between residential area and age-group and reported them if statistically and clinically meaningful. National trends in epididymitis admission rates were examined using generalised linear models. We report incidence rate ratios (IRR) with 95% confidence intervals (95% CI).

The Royal Australian College of General Practitioners National Research and Evaluation Ethics Committee approved the study (NREEC09.019).

RESULTS

Between 2009 and 2014 across Victoria, NSW and Queensland, epididymitis was the main diagnosis in 7375 admissions (94.0% without abscess, 3.3% with abscess, 2.5% with chlamydia, 0.2% with gonorrhea) and 17281 ED presentations (99.7% without abscess) (Supplementary table 1). In EDs, 23.3% of epididymitis diagnoses resulted in hospital admission (20.4%, 95%CI 18.8-22.1 in 2009; 28.4%, 95%CI 26.9-29.9 in 2014). Epididymitis diagnosis rates per 100,000 men increased between 2009 and 2014; in admissions from 28.3 to 38.7 and EDs from 64.8 to 91.9 (Figure 1A). In multivariable analysis (Table 1) the overall epididymitis rate was higher in 2014 than 2009 in admissions (aIRR 1.32, 95%CI 1.20-1.45) and EDs (aIRR 1.40, 95%CI 1.31-1.49). Men 35-44 years experienced the highest admission rates. ED rates were highest for men 15-24 years.

Table 1: Number of epididymitis cases and factors associated with epididymitis rates in Australian hospitals (Victoria, NSW, Queensland), 2009-2014*

	<u>Admission</u>			<u>Emergency Department</u>		
	Cases n	Univariable IRR (95% CI)	Multivariable aIRR (95% CI)	Cases n	Univariable IRR(95% CI)	Multivariable aIRR(95% CI)
Overall	7375			17281		
Age group in years						
15-24	2208	0.83 (0.78-0.89)	0.82 (0.77-0.87)	6205	1.20(1.14-1.25)	1.18(1.13-1.23)
25-34	2510	0.91 (0.86-0.97)	0.91 (0.85-0.97)	5915	1.10(1.05-1.15)	1.10(1.05-1.15)
35-44	2657	1.0	1.0	5161	1.0	1.0
Area of residence						
Metropolitan	5429	1.0	1.0	12101	1.0	1.0
Inner regional	1331	1.11 (1.01-1.21)	1.04 (0.95-1.13)	3748	1.38(1.30-1.47)	1.30(1.22-1.37)
Outer regional/remote	615	1.18 (0.99-1.39)	1.10 (0.93-1.30)	1432	1.43(1.30-1.58)	1.35(1.22-1.49)
SES						
Deciles of increasing disadvantage		1.06 (1.05-1.07)	1.06 (1.05-1.07)		1.06(1.05-1.06)	1.05(1.04-1.05)
Year						
2009	1014	1.0	1.0	2323	1.0	1.0
2010	1143	1.11 (1.00-1.22)	1.10 (1.00-1.21)	2393	1.02(0.95-1.09)	1.02(0.96-1.10)
2011	1247	1.20 (1.09-1.32)	1.19 (1.08-1.31)	2719	1.14(1.07-1.22)	1.14(1.07-1.22)
2012	1259	1.18 (1.07-1.30)	1.17 (1.07-1.29)	3065	1.25(1.17-1.33)	1.26(1.18-1.35)
2013	1251	1.16 (1.05-1.27)	1.16 (1.06-1.27)	3314	1.36(1.27-1.46)	1.37(1.28-1.46)
2014	1461	1.32 (1.21-1.45)	1.32 (1.20-1.44)	3467	1.38(1.29-1.47)	1.40(1.31-1.49)

*Zero inflated poisson regression models

Nationally across Australia between 2009 and 2018, epididymitis was the main diagnosis in 17299 hospital admissions. During the 2009-2014 period of our state-based analysis there were 9459 epididymitis admissions nationally of which 78% were across Victoria, NSW and Queensland and the corresponding population for the three states was 77% of the national ERP. Nationally, the epididymitis admission rate per 100,000 men increased by 3% yearly from 30.9 in 2009 to 38.5 in 2018 (Figure 1B) (IRR 1.03, 95%CI 1.03-1.04, $p<0.01$) and increased across all age groups.

DISCUSSION

This study found for men aged 15-44 years that epididymitis diagnosis rates in hospital admissions and ED attendances in the three most populous Australian states increased by up to 40% between 2009 and 2014. Epididymitis was managed more frequently in ED, where rates were up to 2.5 times those in admissions. Admission rates were highest for older men. ED rates were highest for younger men and in non-metropolitan areas. We found a similar pattern for epididymitis admission rates nationally.

This study applied the same methodology used in our analysis of female STI-related morbidity,(7) therefore, we consider the strengths and limitations to be similar. Notably, this study was strengthened by including ED data to provide new knowledge about epididymitis in Australia. Further, our analysis at postcode level allowed comparison of population rates between areas with different socio-economic characteristics. An important limitation was this study only considered epididymitis managed in hospitals. An Australian study estimated that 14,700 general practice consultations for epididymitis among men aged 15-34 occurred annually during 1998-2003.(6) Primary care data are needed for a more complete picture, but are not routinely available. Further, our ED data did not represent all ED presentations for epididymitis

within the three states. We minimised variability in ED rates by restricting our analysis to EDs providing data for all study years and with high completeness.

Only a handful of studies have investigated epididymitis trends and few if any in the last decade. We found for men aged 15-44 that national epididymitis admission rates per 100,000 increased from 31 in 2009 to 39 in 2018. This contrasts with unchanging admission rates reported for same aged men in Australia (1992-2001) (~35 per 100,000 in 2001) (5) and New Zealand (1998-2008) (~45 per 100,000 in 2008).(9) Our ED rates showed a similar pattern to our admission rates, increasing by 40% during 2009-2014, although overall ED rates were substantially higher than admission rates. We also found that 23% of epididymitis diagnoses in ED were admitted to hospital. This is substantially higher than for Australian general practice during 1998-2003 when <2% epididymitis consultations resulted in hospital referral; although 72% of these encounters were for men >35 years.(6) In the United Kingdom, a comprehensive analysis of general practice data reported declining epididymitis incidence between 2004-2008 for men aged 15-60 with 57% of cases managed completely in general practice. Notably, only 3% of men under 35 years were chlamydia tested.(10)

So, what might contribute to the epididymitis rates observed in this study? Our finding that over three-quarters of epididymitis cases in EDs were managed without admission and that different age groups experienced higher rates in admissions and ED suggests a different aetiology for these settings or differing severity for each aetiology by age group. Admissions data are likely to reflect clinically severe epididymitis; potential causes include chlamydia and gonorrhoea(1), uro-pathogens, or enteric pathogens transmitted via insertive anal intercourse.(2) Recent Australian surveillance data show substantial increases in chlamydia and gonorrhoea diagnosis for men with same sex and female partners, and, an increasing proportion of gay and bisexual

men reporting condomless anal intercourse with casual partners.(3) The latter period of our national analysis also coincided with increasing pre-exposure prophylaxis use by non-HIV-positive men.(3) These factors could contribute to increases in severe epididymitis requiring inpatient management, although the extent is unknown.

Over three-quarters of epididymitis in EDs were managed without admission. Potentially many non-admitted cases were suitable for primary care management. It is possible that factors restricting primary care access contributed to our finding of increased ED rates. A chlamydia testing intervention in Australian general practice (2010-2015) reported a low epididymitis incidence(8) and Australian gay and bisexual men have reported preferences to attend specialist rather than mainstream primary care for sexual health care.(11) Limited availability of sexual health services or general practice workforce shortages, particularly in non-metropolitan areas(12) could limit appointment availability and timely access to general practice thereby prompting men with epididymitis to attend ED instead.

In conclusion, we found increasing epididymitis rates in hospital admissions and EDs, with epididymitis managed more frequently in EDs. Different age-related patterns suggest a different aetiology in these settings. These results could reflect changing sexual practices, increasing STI transmission and/or limited access to general practice, though primary care data are needed to better understand health care usage and the epidemiology of male STI-related morbidity.

Legend for figure 1

Figure 1: A: Hospital admission and emergency department rates of epididymitis per 100,000 men (in Victoria, NSW and Queensland) by age group, 2009-2014; and, B: Australian admission rates of epididymitis per 100,000 men by age group, 2009-2018.

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Competing interests None to declare.

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